MULTIPLEX LOOP ANTENNA

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Inventor: SATO SAKIKO; MASUDA YOSHIYUKI; OTANI NOBORU
Applicant: SHARP KK

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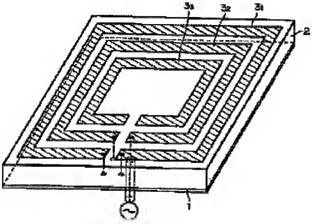
Abstract of **JP2000269724**

PROBLEM TO BE SOLVED: To provide antenna equipment which switches a desired frequency with a simple and small-sized structure, without using a matching circuit. SOLUTION: A copper foil on one face of a substrate is used as a ground conductor 1, and a dielectric layer 2 consisting of a glass epoxy resin plate is provided on it, and loop conductors 31 to 33 consisting of strip lines of a copper foil are formed on the upper face of this layer 2, thus constituting the antenna equipment. The loop conductor 32 is a feed loop and has one end grounded to the conductor 1 and has the other end connected to a coaxial line. When both ends of the loop conductors 31 are grounded to the conductor 1 and those of the loop conductors 33 are connected to an insulating end, the frequency component of the loop antenna corresponding to the loop length of the loop conductors 31 is detected. When both ends of the loop conductors 31 are grounded to the conductor 1 and those of the loop conductors 33 are connected to an insulating end, the loop conductor 31 is excited and a frequency component of the loop antenna corresponding to the loop length of the loop conductors 31 is detected by the feed loop conductor 32. When both ends of the loop conductors 31 are grounded to the conductor 1 and both ends of the loop conductors 31 are connected to the insulating end, the loop conductor 33 is excited, and the frequency components of the loop antenna corresponding to the loop length of the loop conductors 33 are detected by the conductor 32.



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(71)出願人　000005049
シャープ株式会社
大阪府大阪市阿倍野区長池町22番22号

(72)発明者　佐藤　咲子
大阪府大阪市阿倍野区長池町22番22号　シャープ株式会社内

(72)発明者　増田　義行
大阪府大阪市阿倍野区長池町22番22号　シャープ株式会社内

(74)代理人　100079843
弁理士　高野　明近

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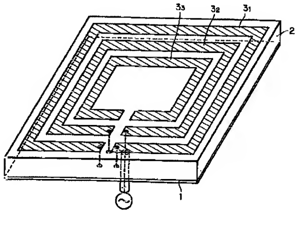
(54)【発明の名称】　多重ループアンテナ

(57)【要約】

【課題】　構造が、簡易小型で、整合回路を用いることなく、所望の周波数の切り替えが可能なアンテナ装置を提供する。

【解決手段】　基板の一方の面の銅箔を接地導体１、その上にガラスエポキシ樹脂板からなる誘電体層２を設け、その上面に銅箔のストリップラインからなるループ導体3_1～3_3を形成してアンテナ装置を構成した。ループ導体3_2は、給電ループで、一端は接地導体１に接地され、他端は同軸線路に接続されている。ループ導体3_1の両端を接地導体１に接地し、ループ3_3の両端を絶縁端に接続すると、ループ導体3_1は励振し、給電ループ導体3_2により、ループ導体3_1のループ長に相当するループアンテナの周波数の成分が検出される。ループ導体3_3の両端を、接地導体に接地し、ループ導体3_1の両端を、絶縁端に接続すると、ループ導体3_3は励振し、給電ループ導体3_2により、ループ導体3_3のループ長に相当するループアンテナの周波数成分が検出される。



【特許請求の範囲】

【請求項１】　接地導体と、誘電体層と、該誘電体層を介して設けられた少なくとも２つ以上の相似的なループ導体から成る多重ループアンテナであって、前記ループ導体の１つは、給電ループとして、それ以外のループ導体は、無給電ループとして作動されることを特徴とする多重ループアンテナ。

【請求項２】　前記誘電体層として誘電体板を用い、該誘電体板の一方の面に前記接地導体を設け、前記ループ導体として、前記誘電体板の他方の面にストリップラインで少なくとも２つ以上の相似的なループ導体を形成したことを特徴とする請求項１に記載の多重ループアンテナ。

【請求項３】　前記少なくとも２つ以上の相似的なループ導体の各ループ導体は、所望の励振周波数に対応した１波長方形ループ導体であることを特徴とする請求項１または２に記載の多重ループアンテナ。

【請求項４】　前記給電ループとして作動されるループ導体の一端は、前記接地導体に接地され、他端は同軸線路等の給電線に接続され、かつ、前記無給電ループとして作動されるループ導体は、その両端が前記接地導体に接地されていることを特徴とする請求項１乃至３のいずれか一項に記載の多重ループアンテナ。

【請求項５】　前記無給電ループとして作動されるループ導体に励振した信号を、それと隣接して設けられた前記給電ループとして作動されるループ導体により検出することを特徴とする請求項１乃至４のいずれか一項に記載の多重ループアンテナ。

【請求項６】　前記少なくとも２つ以上の相似的なループ導体の各ループ導体の一端を、前記接地導体に接地し、他端をスイッチ等により前記同軸線路等の給電線、または、絶縁端に切り替えることにより、給電ループ，無給電ループを変更し、アンテナ励振周波数を切り替えることを特徴とする請求項１乃至３のいずれか一項に記載の多重ループアンテナ。

【請求項７】　中央に前記給電ループとして作動されるループ導体、その内側と外側に前記無給電ループとして作動されるループ導体が配置されてなるアンテナであって、前記内側ループ導体の周波数を読み出すときは、前記内側ループ導体の両端を前記接地導体に接地し、前記外側ループ導体の両端は絶縁端に接続し、また、前記外側ループ導体の周波数を読み出すときは、前記外側ループ導体の両端を前記接地導体に接地し、前記内側ループ導体の両端は絶縁端に接続することで周波数の切り替えを行う３つのループ導体からなることを特徴とする請求項６に記載の多重ループアンテナ。

【請求項８】　２つのループ導体からなる多重ループアンテナであって、それぞれのループ導体の一端を前記接地導体に接地し、読み出したい周波数のループ導体の他端を前記接地導体に接続し、もう一方のループ導体の他端を前記同軸線路等の給電線路に接続することで、周波数の切り替えを行う請求項６に記載の多重ループアンテナ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、アンテナ装置、詳しくは無線電話等に使用される周波数切り替えが可能なループアンテナ装置に関する。

【０００２】

【従来の技術】近年、携帯電話等の移動体携帯無線端末の普及が急速に進んでおり、さらに、近い将来には莫大な数の無線機の利用が予想される。また、携帯電話に加え、２０００年以降の地上波データ放送等、複数の周波数帯を利用した情報通信サービスが予定されており、一台の端末で複数のサービスを利用するために、小型，広帯域、または複数の帯域で動作するアンテナが必要とされている。

【０００３】現在の携帯電話等の通信端末では、各利用周波数ごとに対応したアンテナが設けられるのが一般的であるが、複数の周波数に対応する周波数切り替えアンテナも報告されている。例えば、従来の周波数切り替え式アンテナはアレーアンテナ素子を改良した例として、各周波数帯域のパッチアンテナを、多層状に積み重ねた構造のアンテナ（以下、「パッチ多層アンテナ」という）が提案されている（「図説・アンテナ」（社）電子情報通信学会Ｐ．２２９）。

【０００４】また、周波数の切り替えをアンテナの整合回路のインダクタンス値をトランジスタ等で切り替える構造のアンテナが提案されている（武部、東：“携帯無線機における周波数切替式小型アンテナ”１９９７年信学通信ソサイエティ大会Ｂ－１－５２）。これは、アンテナエレメントに形成した給電用パターンにおいて、給電を容量結合により行い、インダクタンス値をＰＩＮダイオードで切り替えることにより、共振周波数を切り替えるものである。しかしながら、前者のパッチ多層アンテナの構造は、複数のアンテナを積み上げる構造となっており、アンテナ構造、及び給電方法が複雑になってしまうという問題がある。また、後者の周波数の切り替えを、アンテナの整合回路のインダクタンス値を、トランジスタ等で切り替える構造のアンテナは、周波数の切り替えに限界があり、また、整合回路系が複雑になるという問題がある。

【０００５】

【発明が解決しようとする課題】本発明は、従来のアンテナのこのような課題を解決するためになされたもので、アンテナ構造、及び給電構成が、簡易で小型であり、また、複雑な整合回路による周波数の切り替えを行わなくても、所望の周波数の切り替えが可能となるアンテナ装置を提供することを目的としている。

【０００６】

【課題を解決するための手段】請求項１の発明は、接地導体と、誘電体層と、該誘電体層を介して設けられた少なくとも２つ以上の相似的なループ導体から成る多重ループアンテナであって、前記ループ導体の１つは、給電ループとして、それ以外のループ導体は、無給電ループとして作動されるようにしたものである。

【０００７】請求項２の発明は、請求項１に記載の多重ループアンテナにおいて、前記誘電体層として誘電体板を用い、該誘電体板の一方の面に前記接地導体を設け、前記ループ導体として、前記誘電体板の他方の面にストリップラインで少なくとも２つ以上の相似的なループ導体を形成したものである。

【０００８】請求項３の発明は、請求項１または２に記載の多重ループアンテナにおいて、前記少なくとも２つ以上の相似的なループ導体の各ループ導体を、所望の励振周波数に対応した１波長方形ループ導体としたものである。

【０００９】請求項４の発明は、請求項１乃至３のいずれか一項に記載の多重ループアンテナにおいて、前記給電ループとして作動されるループ導体の一端を、前記接地導体に接地し、他端を同軸線路等の給電線に接続し、かつ、前記無給電ループとして作動されるループ導体については、その両端を前記接地導体に接地したものである。

【００１０】請求項５の発明は、請求項１乃至４のいずれか一項に記載の多重ループアンテナにおいて、前記無給電ループとして作動されるループ導体に励振した信号を、それと隣接して設けられた前記給電ループとして作動されるループ導体により検出するようにしたものである。

【００１１】請求項６の発明は、請求項１乃至３のいずれか一項に記載の多重ループアンテナにおいて、前記少なくとも２つ以上の相似的なループ導体の各ループ導体の一端を、前記接地導体に接地し、他端をスイッチ等により前記同軸線路等の給電線、または、絶縁端に切り替えることにより、給電ループ，無給電ループを変更し、アンテナ励振周波数を切り替えるようにしたものである。

【００１２】請求項７の発明は、請求項６に記載の多重ループアンテナにおいて、中央に前記給電ループとして作動されるループ導体、その内側と外側に前記無給電ループとして作動されるループ導体が配置されてなるアンテナであって、前記内側ループ導体の周波数を読み出すときは、前記内側ループ導体の両端を前記接地導体に接地し、前記外側ループ導体の両端は絶縁端に接続し、また、前記外側ループ導体の周波数を読み出すときは、前記外側ループ導体の両端を前記接地導体に接地し、前記内側ループ導体の両端は絶縁端に接続することで周波数の切り替えを行うようにしたものである。

【００１３】請求項８の発明は、請求項６に記載の多重ループアンテナにおいて、２つのループ導体を用い、それぞれのループ導体の一端を前記接地導体に接地し、読み出したい周波数のループ導体の他端を、前記接地導体に接続し、もう一方のループ導体の他端を、前記同軸線路等の給電線路に接続することで周波数の切り替えを行うようにしたものである。

【００１４】

【発明の実施の形態】本発明の多重ループアンテナは、板状の接地導体上に誘電体層を設け、その上面にアンテナループ構造が順次形成されて構成される。本発明に使用する接地導体としては、特に限定されるものはないが、導電性が高い銅等の導体が望ましい。また、誘電体層に使用する誘電体材料としては、ガラスエポキシ樹脂，テフロン（登録商標），アルミナ等の高周波領域での誘電損失が小さいものが望ましい。そして、アンテナループに使用する材料としては、高周波領域での導体損が小さく、加工しやすい銅等の導電性材料が望ましい。以下に、本発明を、その実施の形態を示す図面に基づいて説明する。

【００１５】（実施の形態１）図１は、本発明に係る多重ループアンテナの一実施例の斜視図である。ここでは、板状のガラスエポキシ樹脂の両面に銅箔を被覆した基板を用いて、基板の一方の面の銅箔を接地導体とし、もう一方の面の銅箔をストリップラインのループアンテナに加工して、アンテナ装置を作製した。基板の一方の面の銅箔が接地導体１、その上にガラスエポキシ樹脂板からなる誘電体層２，その上面に銅箔のストリップラインからなるループ導体3_1～3_3が順次形成されている。使用したガラスエポキシ樹脂板の厚さは１．６ｍｍで、ストリップラインのループアンテナの線幅は、ここではすべて１．５ｍｍとした。

【００１６】図2は、図１の多重ループアンテナのループ構成を説明するための図である。ここで、アンテナループの全長Ｌは、アンテナの送受信電波の実行波長λｇで規定され、アンテナの送受信電波の実行波長λｇは、真空中あるいは空気中を伝搬する電波の波長をλ、ストリップラインとしての実効誘電率をεｅｆｆとすると、次式

$$\lambda g = \lambda / \sqrt{\varepsilon eff}$$

で表される。このとき、ループ全長Ｌ＝λｇとすると、ループ導体3_1は、周波数＝５５０ＭＨｚに相当するループアンテナである。ループ導体3_2は、周波数＝６０８ＭＨｚに相当するループアンテナである。ループ導体3_3は、周波数＝６８０ＭＨｚに相当するループアンテナである。

【００１７】ループ導体3_2は、給電ループで、一端は接地導体１に接地され、他端は同軸線路に接続されている。ループ導体3_1と、ループ導体3_3には、図２（Ｂ）に示すように、それぞれ２個所の切り替え用のスイッチが設けられている。まず、ループ導体3_1の読み出し方

法を、図面を参照して説明する。図２（Ａ）に示すように、ループ導体$３_１$の両端を、接地導体１に接地し、ループ導体$３_３$の両端を、絶縁端に接続する。ループ導体$３_１$のループ端の切り替えスイッチの接続状態図を、図２（Ｃ）に、ループ導体$３_３$のループ端の切り替えスイッチの接続状態図を、図２（Ｄ）にそれぞれ示す。このとき、ループ導体$３_１$は励振し、隣接した給電ループ導体$３_２$により、上記したループ導体$３_１$のループ長に相当するループアンテナの周波数の成分が検出される。このアンテナ装置のリターンロス（ＲＬ）特性と，定在波比特性（ＳＷＲ）を、図３（Ａ）に示す。

【００１８】図３（Ａ）によれば、５５０ＭＨｚ付近で共振し、定在波比（ＳＷＲ）の値も良好であることがわかる。また、２７５ＭＨｚ付近で、アンテナ全長Ｌ＝２λｇに相当する周波数で共振しているため、２７５ＭＨｚ付近の周波数も検出されている。

【００１９】次に、比較例として、図２（Ｆ）に示すように、ループ導体$３_１$の一端を、接地導体に接地し、他端を絶縁端に接続し、ループ導体$３_３$の両端を、絶縁端に接続して同様に計測した。このとき、ループ導体$３_１$は、励振せず、隣接したループ導体$３_２$により、ループ導体$３_１$のループ長に相当するループアンテナに相当する周波数成分は検出されなかった。

【００２０】次に、ループ導体$３_３$の読み出し方法を、図面を参照して説明する。図２（Ｅ）に示すように、ループ導体$３_３$の両端を、接地導体に接地し、ループ導体$３_１$の両端を、絶縁端に接続する。ループ導体$３_１$のループ端の切り替えスイッチの接続状態図を、図２（Ｄ）に、ループ導体$３_３$のループ端の切り替えスイッチの接続状態図を、図２（Ｃ）に示す。このとき、ループ導体３は励振し、隣接した給電ループ導体$３_２$により、ループ導体$３_３$の上記したループ長に相当するループアンテナの周波数成分が検出される。この場合の、アンテナ装置のリターンロス（ＲＬ）特性，定在波比（ＳＷＲ）特性を、図３（Ｂ）に示す。図３（Ｂ）によれば、６８０ＭＨｚ付近で共振し、定在波比（ＳＷＲ）の値も良好であることがわかる。ここでも、同様にアンテナ全長Ｌ＝２λｇで共振が起こっているため、３４０ＭＨｚ付近の周波数も検出されている。

【００２１】（実施の形態２）図4は、本発明の多重ループアンテナの他の実施例を示す斜視図である。この実施例のアンテナも、板状のガラスエポキシ樹脂の両面に銅箔を被覆した基板を用いて、基板の一方の面の銅箔を接地導体とし、もう一方の面の銅箔をストリップラインのループアンテナに加工して作製した。基板の一方の面の銅箔が接地導体１、その上にガラスエポキシ樹脂板からなる誘電体層２，その上面に銅箔のストリップラインからなるループ導体構造$３_１$，$３_２$が順次形成されている。前記実施例と同様、使用したガラスエポキシ樹脂板の厚さは１．６ｍｍである。また、ストリップラインのループ導体アンテナの線幅は、ここではすべて１．５ｍｍである。

【００２２】図5は、図4の多重ループアンテナのループ構造を説明するための図である。ここでも、アンテナループ全長Ｌはλｇで規定され、

$\lambda g=\lambda/\sqrt{\varepsilon eff}$

（εｅｆｆ：ストリップラインとしての実効誘電率）で表される。このとき、ループ全長Ｌ＝λｇとすると、ループ導体$３_１$は、周波数＝６０８ＭＨｚに相当するループアンテナである。ループ導体$３_２$は、周波数＝７４０ＭＨｚに相当するループアンテナである。

【００２３】また、二つのループ導体$３_１$，$３_２$ともそれぞれ、一方のループ端は接地導体に接地されており、もう一方のループ端の接続方法の違いにより、二つの周波数の切り替えを行うものである。両ループ導体$３_１$，$３_２$には、図５（Ｂ）に示すように、ループ導体のもう一方の端部には、接地側と、給電線路側に切り替える１個の切り替え用のスイッチが設けられている。

【００２４】まず、ループ導体$３_１$の読み出し方法を、図面に従って説明する。図５（Ａ）に示すように、ループ導体$３_１$の両端を接地導体に接地し、ループ導体$３_２$の一端を給電線路に接続する。このとき、ループ導体$３_１$は励振し、隣接した給電ループ導体$３_２$により、ループ導体$３_１$のループ長に相当するループアンテナの周波数成分が検出される。このアンテナ装置のリターンロス（ＲＬ）特性，定在波比（ＳＷＲ）特性を、図６（Ａ）に示す。

【００２５】６０８ＭＨｚ付近で共振し、定在波比（ＳＷＲ）の値も良好であることがわかる。また、この特性では３００ＭＨｚ付近で、アンテナ全長Ｌ＝２λｇで共振が起こっているため、３００ＭＨｚ付近の周波数も検出されていることがわかる。

【００２６】次に、ループ導体$３_２$の読み出し方法を図に従って説明する。図５（Ｃ）に示すように、ループ導体$３_２$の両端を接地導体１に接地し、ループ導体$３_１$の一端を給電線路に接続する。このとき、ループ導体$３_２$は励振し、隣接した給電ループ導体$３_１$により、ループ導体$３_２$のループ長に相当するアンテナの周波数成分が検出される。このアンテナ装置のリターンロス（ＲＬ）特性，定在波比（ＳＷＲ）特性を、図６（Ｂ）に示す。

【００２７】７４０ＭＨｚ付近で共振し、定在波比（ＳＷＲ）の値も良好であることがわかる。ここでも、同様にアンテナ全長Ｌ＝２λｇで共振が起こっているため、３７０ＭＨｚ付近の周波数も検出されていることがわかる。

【００２８】

【発明の効果】以上のように、本発明の多重ループアンテナによれば、給電ループ導体と無給電ループ導体が隣接してなる簡易な構成であり、周波数を切り替える従来の周波数切り替え式アンテナに比べ、複雑な整合回路は

不要で、アンテナの小型化が実現できる。

【図面の簡単な説明】

【図1】本発明の多重ループアンテナの一実施例を示す斜視図である。

【図2】図1の多重ループアンテナのループ導体構成を説明するための図である。

【図3】図1の多重ループアンテナのリターンロス（RL）特性と、定在波比（SWR）特性を示す図である。

【図4】本発明の多重ループアンテナの他の実施例を示す斜視図である。

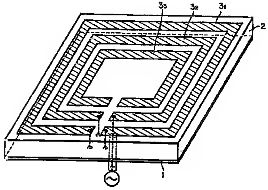
【図5】図4の多重ループアンテナのループ導体構成を説明するための図である。

【図6】図4の多重ループアンテナのリターンロス（RL）特性と、定在波比（SWR）特性を示すグラフである。

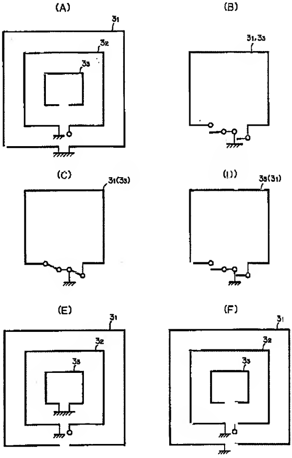
【符号の説明】

1…接地導体、2…誘電体層、3_1〜3_3…ループ導体。

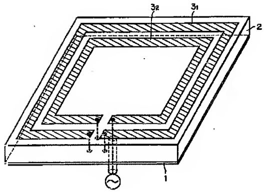
【図1】



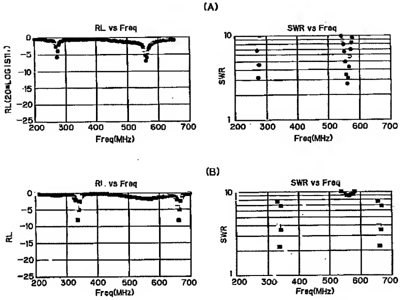
【図2】



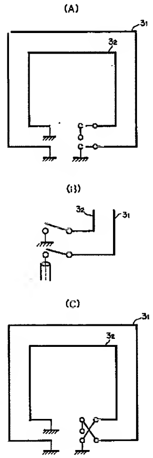
【図4】



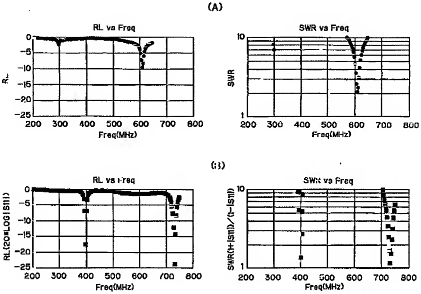
【図3】


(A)
RL vs Freq
RL(20*LOG|S11|)
Freq(MHz)
SWR vs Freq
SWR
Freq(MHz)
(B)
RL vs Freq
RL
Freq(MHz)
SWR vs Freq
SWR
Freq(MHz)

【図5】


(A)
3_1
3_2
(B)
3_2
3_1
(C)
3_1
3_2

【図6】



フロントページの続き

(72)発明者 大谷 昇
大阪府大阪市阿倍野区長池町22番22号 シャープ株式会社内

Fターム(参考) 5J046 AA01 AA07 AA12 AB11 PA07

* NOTICES *

JPO and INPIT are not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] touch-down -- at least two or more similarity-loop formations established through the conductor, the dielectric layer, and this dielectric layer -- the multiplex loop antenna which consists of a conductor -- it is -- said loop formation -- the loop formation as an electric supply loop formation with other one of the conductors -- the multiplex loop antenna characterized by a conductor operating as a loop formation non-supplied electric power.
[Claim 2] as said dielectric layer -- a dielectric plate -- using -- one field of this dielectric plate -- said touch-down -- a conductor -- preparing -- said loop formation -- as a conductor -- the field of another side of said dielectric plate -- a stripline -- at least two or more similarity-loop formations -- the multiplex loop antenna according to claim 1 characterized by forming a conductor.
[Claim 3] said at least two or more similarity-loop formations -- each loop formation of a conductor -- the one-wave rectangle loop formation corresponding to a desired exciting frequency in a conductor -- the multiplex loop antenna according to claim 1 or 2 characterized by being a conductor.
[Claim 4] the loop formation which operates as said electric supply loop formation -- the end of a conductor -- said touch-down -- the loop formation which it is grounded by the conductor, and the other end is connected to feeders, such as a coaxial track, and operates as said loop formation non-supplied electric power -- a conductor -- the both ends -- said touch-down -- a multiplex loop antenna given in claim 1 characterized by being grounded by the conductor thru/or any 1 term of 3.
[Claim 5] the loop formation which operates as said loop formation non-supplied electric power -- the loop formation which operates as said electric supply loop formation which adjoined it and was established in the signal excited to the conductor -- a multiplex loop antenna given in claim 1 characterized by detecting with a conductor thru/or any 1 term of 4.
[Claim 6] said at least two or more similarity-loop formations -- each loop formation of a conductor -- the end of a conductor -- said touch-down -- a multiplex loop antenna given in claim 1 characterized by changing an electric supply loop formation and the loop formation non-supplied electric power, and changing an antenna exciting frequency by grounding to a conductor and changing the other end to a feeder or insulating edges, such as said coaxial track, with a switch etc. thru/or any 1 term of 3.
[Claim 7] It is the antenna with which it comes to arrange a conductor. the loop formation which operates as said electric supply loop formation in the center -- the loop formation which operates as said loop formation non-supplied electric power on a conductor, and its inside and outside -- said inner loop, when reading the frequency of a conductor said inner loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said outer loop -- the both ends of a conductor -- an insulating edge -- connecting -- moreover, said outer loop, when reading the frequency of a conductor said outer loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said inner loop -- three loop formations which change a frequency by connecting the both ends of a conductor to an insulating edge -- the multiplex loop antenna according to claim 6 characterized by consisting of a conductor.
[Claim 8] two loop formations -- the multiplex loop antenna which consists of a conductor -- it is -- each loop formation -- the end of a conductor -- said touch-down -- the loop formation of a frequency to

ground and read to a conductor -- the other end of a conductor -- said touch-down -- a conductor -- connecting -- another loop formation -- the multiplex loop antenna according to claim 6 which changes a frequency by connecting the other end of a conductor to feeder ways, such as said coaxial track.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to antenna equipment and the loop antenna equipment in which the frequency change used for radiotelephony etc. in detail is possible.
[0002]
[Description of the Prior Art] In recent years, the spread of mobile walkie-talkie terminals, such as a cellular phone, is progressing quickly, and use of an immense number of walkie-talkies is expected in the still nearer future. Moreover, in order to plan the telecommunications service which used two or more frequency bands, such as terrestrial data broadcasting in 2000 and afterwards, in addition to the cellular phone and to use two or more services by one set of a terminal, the antenna which operates in small, a broadband, or two or more bands is needed.
[0003] Although it is common in communication terminals, such as the present cellular phone, that the antenna which corresponded for every use frequency is formed, the frequency change antenna corresponding to two or more frequencies is also reported. For example, the antenna (henceforth a "patch multilayer antenna") of the structure which accumulated the patch antenna of each frequency band in the shape of a multilayer is proposed as an example for which the conventional frequency change type antenna improved the array antenna component (illustration and "antenna" Institute of Electronics, Information and Communication Engineers P.229).
[0004] Moreover, the antenna of the structure changed with a transistor etc. is proposed [value / of the matching circuit of an antenna / inductance] in the change of a frequency (Takebe, east:"frequency change type miniaturized antenna in field radio" 1997 **** communication link society convention B-1-52). This changes resonance frequency in the pattern for electric supply formed in the antenna element by supplying electric power by capacity coupling and changing an inductance value by the PIN diode. However, the structure of the former patch multilayer antenna is the structure which accumulates two or more antennas, and there are antenna structure and a problem that the electric supply approach will become complicated. Moreover, in the change of the latter frequency, the antenna of the structure changed with a transistor etc. has a limitation in the change of a frequency, and has [value / of the matching circuit of an antenna / inductance] the problem that a matching circuit system becomes complicated.
[0005]
[Problem(s) to be Solved by the Invention] This invention was made in order to solve such a technical problem of the conventional antenna, and it aims to let antenna structure and an electric supply configuration offer the antenna equipment whose change of a desired frequency is attained simply and small, even if it does not change the frequency by the complicated matching circuit.
[0006]
[Means for Solving the Problem] invention of claim 1 -- touch-down -- at least two or more similarity-loop formations established through the conductor, the dielectric layer, and this dielectric layer -- the multiplex loop antenna which consists of a conductor -- it is -- said loop formation -- the loop formation

as an electric supply loop formation with other one of the conductors -- it is made for a conductor to operate as a loop formation non-supplied electric power
[0007] invention of claim 2 -- a multiplex loop antenna according to claim 1 -- setting -- as said dielectric layer -- a dielectric plate -- using -- one field of this dielectric plate -- said touch-down -- a conductor -- preparing -- said loop formation -- as a conductor -- the field of another side of said dielectric plate -- a stripline -- at least two or more similarity-loop formations -- a conductor is formed.
[0008] invention of claim 3 -- a multiplex loop antenna according to claim 1 or 2 -- setting -- said at least two or more similarity-loop formations -- each loop formation of a conductor -- the one-wave rectangle loop formation corresponding to a desired exciting frequency for a conductor -- it considers as a conductor.
[0009] the loop formation to which invention of claim 4 operates as said electric supply loop formation in a multiplex loop antenna given in claim 1 thru/or any 1 term of 3 -- the end of a conductor -- said touch-down -- the loop formation which grounds to a conductor, and connects the other end to feeders, such as a coaxial track, and operates as said loop formation non-supplied electric power -- a conductor -- the both ends -- said touch-down -- it grounds to a conductor.
[0010] the loop formation to which invention of claim 5 operates as said loop formation non-supplied electric power in the multiplex loop antenna of a publication in claim 1 thru/or any 1 term of 4 -- the loop formation which operates as said electric supply loop formation which adjoined it and was established in the signal excited to the conductor -- it is made for a conductor to detect
[0011] invention of claim 6 -- a multiplex loop antenna given in claim 1 thru/or any 1 term of 3 -- setting -- said at least two or more similarity-loop formations -- each loop formation of a conductor -- the end of a conductor -- said touch-down -- by grounding to a conductor and changing the other end to a feeder or insulating edges, such as said coaxial track, with a switch etc., an electric supply loop formation and the loop formation non-supplied electric power are changed, and an antenna exciting frequency is changed.
[0012] Invention of claim 7 is set to a multiplex loop antenna according to claim 6. It is the antenna with which it comes to arrange a conductor. the loop formation which operates as said electric supply loop formation in the center -- the loop formation which operates as said loop formation non-supplied electric power on a conductor, and its inside and outside -- said inner loop, when reading the frequency of a conductor said inner loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said outer loop -- the both ends of a conductor -- an insulating edge -- connecting -- moreover, said outer loop, when reading the frequency of a conductor said outer loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said inner loop -- the both ends of a conductor are made to change a frequency by connecting with an insulating edge.
[0013] invention of claim 8 -- a multiplex loop antenna according to claim 6 -- setting -- two loop formations -- a conductor -- using -- each loop formation -- the end of a conductor -- said touch-down -- the loop formation of a frequency to ground and read to a conductor -- the other end of a conductor -- said touch-down -- a conductor -- connecting -- another loop formation -- it is made to change a frequency by connecting the other end of a conductor to feeder ways, such as said coaxial track.
[0014]
[Embodiment of the Invention] the multiplex loop antenna of this invention -- tabular touch-down -- a conductor -- a dielectric layer is prepared upwards, sequential formation is carried out and antenna loop structure is constituted by the top face. the touch-down used for this invention -- although there is especially nothing that is limited as a conductor, conductors, such as copper with high conductivity, are desirable. Moreover, as dielectric materials used for a dielectric layer, what has the small dielectric loss in RF fields, such as a glass epoxy resin, Teflon (trademark), and an alumina, is desirable. and -- as the ingredient used for an antenna loop -- the conductor in a RF field -- loss is small and conductive ingredients, such as copper which is easy to process it, are desirable. Below, this invention is explained based on the drawing in which the gestalt of the operation is shown.
[0015] (Gestalt 1 of operation) Drawing 1 is the perspective view of one example of the multiplex loop antenna concerning this invention. the substrate which covered copper foil here to both sides of a tabular glass epoxy resin -- using -- the copper foil of one field of a substrate -- touch-down -- it considered as

the conductor, the copper foil of another field was processed into the loop antenna of a stripline, and antenna equipment was produced. the copper foil of one field of a substrate -- touch-down -- the loop formation which becomes a conductor 1, the dielectric layer 2 which consists of a glass epoxy resin plate on it, and its top face from the stripline of copper foil -- sequential formation of the conductors 31-33 is carried out. The thickness of the used glass epoxy resin plate is 1.6mm, and line breadth of the loop antenna of a stripline was altogether set to 1.5mm here.

[0016] Drawing 2 is drawing for explaining the loop arrangement of the multiplex loop antenna of drawing 1 . Here, the overall length L of an antenna loop is prescribed by activation wavelength lambdag of the sending and receiving electric wave of an antenna, and activation wavelength lambdag of the sending and receiving electric wave of an antenna is expressed with degree type lambda g=lambda / rootepsiloneff when lambda and the effective dielectric constant as a stripline are set to epsiloneff for the wavelength of the electric wave which spreads the inside of a vacuum or air. at this time if loop-formation overall-length L=lambdag -- a loop formation -- a conductor 31 is a loop antenna equivalent to frequency =550MHz. a loop formation -- a conductor 32 is a loop antenna equivalent to frequency =608MHz. a loop formation -- a conductor 33 is a loop antenna equivalent to frequency =680MHz.

[0017] a loop formation -- a conductor 32 -- an electric supply loop formation -- it is -- an end -- touch-down -- it is grounded by the conductor 1 and the other end is connected to the coaxial track. a loop formation -- a conductor 31 and a loop formation -- as shown in a conductor 33 at drawing 2 (B), two switches for a change are formed, respectively. first, a loop formation -- an approach to read a conductor 31 is explained with reference to a drawing. it is shown in drawing 2 (A) -- as -- a loop formation -- the both ends of a conductor 31 -- touch-down -- a conductor 1 -- grounding -- a loop formation -- the both ends of a conductor 33 are connected to an insulating edge. a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 31 -- drawing 2 (C) -- a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 33 is shown in drawing 2 (D), respectively. this time -- a loop formation -- the electric supply loop formation which excited the conductor 31 and adjoined -- the loop formation described above with the conductor 32 -- the component of the frequency of the loop antenna equivalent to the loop-formation length of a conductor 31 is detected. The return loss (RL) property and standing-wave ratio property (SWR) of this antenna equipment are shown in drawing 3 (A).

[0018] According to drawing 3 (A), it resonates near 550MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Moreover, near 275MHz, since it is resonating on the frequency equivalent to antenna overall-length L=2lambdag, the frequency near 275MHz is also detected.

[0019] next, it is shown in drawing 2 (F) as an example of a comparison -- as -- a loop formation -- the end of a conductor 31 -- touch-down -- a conductor -- grounding -- the other end -- an insulating edge -- connecting -- a loop formation -- it connected with the insulating edge and the both ends of a conductor 33 were measured similarly. this time -- a loop formation -- the loop formation which did not excite the conductor 31 but adjoined -- a conductor 32 -- a loop formation -- the frequency component equivalent to the loop antenna equivalent to the loop-formation length of a conductor 31 was not detected.

[0020] next, a loop formation -- an approach to read a conductor 33 is explained with reference to a drawing. it is shown in drawing 2 (E) -- as -- a loop formation -- the both ends of a conductor 33 -- touch-down -- a conductor -- grounding -- a loop formation -- the both ends of a conductor 31 are connected to an insulating edge. a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 31 -- drawing 2 (D) -- a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 33 is shown in drawing 2 (C). this time -- a loop formation -- the electric supply loop formation which excited the conductor 3 and adjoined -- a conductor 32 -- a loop formation -- the frequency component of the loop antenna equivalent to the loop-formation length which the conductor 33 described above is detected. The return loss (RL) property of antenna equipment in this case and a standing-wave ratio (SWR) property are shown in drawing 3 (B). According to drawing 3 (B), it resonates near 680MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Here, since resonance has taken

place by antenna overall-length L=2lambdag similarly, the frequency near 340MHz is also detected.
[0021] (Gestalt 2 of operation) Drawing 4 is the perspective view showing other examples of the multiplex loop antenna of this invention. the substrate with which the antenna of this example also covered copper foil to both sides of a tabular glass epoxy resin -- using -- the copper foil of one field of a substrate -- touch-down -- it considered as the conductor, and the copper foil of another field was processed into the loop antenna of a stripline, and was produced. the copper foil of one field of a substrate -- touch-down -- the loop formation which becomes a conductor 1, the dielectric layer 2 which consists of a glass epoxy resin plate on it, and its top face from the stripline of copper foil -- a conductor -- sequential formation of the structures 31 and 32 is carried out. The thickness of the used glass epoxy resin plate is 1.6mm like said example. moreover, the loop formation of a stripline -- a conductor -- the line breadth of an antenna is 1.5mm altogether here.
[0022] Drawing 5 is drawing for explaining the loop structure of the multiplex loop antenna of drawing 4 . Here, the antenna loop overall length L is prescribed by lambdag, and is expressed with lambda g=lambda / rootepsiloneff (epsiloneff: effective dielectric constant as a stripline). at this time if loop-formation overall-length L=lambdag -- a loop formation -- a conductor 31 is a loop antenna equivalent to frequency =608MHz. a loop formation -- a conductor 32 is a loop antenna equivalent to frequency =740MHz.
[0023] moreover, two loop formations -- conductors 31 and 32 -- respectively -- one loop-formation edge -- touch-down -- it is grounded by the conductor and two frequencies are changed by the difference in the connection method of another loop-formation edge. both loop formations -- it is shown in conductors 31 and 32 at drawing 5 (B) -- as -- a loop formation -- one switch for a change changed to the earth side and a feeder road side is formed in another edge of a conductor.
[0024] first, a loop formation -- an approach to read a conductor 31 is explained according to a drawing. it is shown in drawing 5 (A) -- as -- a loop formation -- the both ends of a conductor 31 -- touch-down -- a conductor -- grounding -- a loop formation -- the end of a conductor 32 is connected to a feeder way. this time -- a loop formation -- the electric supply loop formation which excited the conductor 31 and adjoined -- a conductor 32 -- a loop formation -- the frequency component of the loop antenna equivalent to the loop-formation length of a conductor 31 is detected. The return loss (RL) property of this antenna equipment and a standing-wave ratio (SWR) property are shown in drawing 6 (A).
[0025] It resonates near 608MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Moreover, in this property, near 300MHz, since resonance has taken place by antenna overall-length L=2lambdag, it turns out that the frequency near 300MHz is also detected.
[0026] next, a loop formation -- an approach to read a conductor 32 is explained according to drawing. it is shown in drawing 5 (C) -- as -- a loop formation -- the both ends of a conductor 32 -- touch-down -- a conductor 1 -- grounding -- a loop formation -- the end of a conductor 31 is connected to a feeder way. this time -- a loop formation -- the electric supply loop formation which excited the conductor 32 and adjoined -- a conductor 31 -- a loop formation -- the frequency component of the antenna equivalent to the loop-formation length of a conductor 32 is detected. The return loss (RL) property of this antenna equipment and a standing-wave ratio (SWR) property are shown in drawing 6 (B).
[0027] It resonates near 740MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Here, since resonance has taken place by antenna overall-length L=2lambdag similarly, it turns out that the frequency near 370MHz is also detected.
[0028]
[Effect of the Invention] as mentioned above -- according to the multiplex loop antenna of this invention -- an electric supply loop formation -- a conductor and the loop formation non-supplied electric power -- it is the simple configuration that a conductor comes to adjoin, and compared with the conventional frequency change type antenna which changes a frequency, a complicated matching circuit is unnecessary and the miniaturization of an antenna can be realized.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to antenna equipment and the loop antenna equipment in which the frequency change used for radiotelephony etc. in detail is possible.

[Translation done.]

PRIOR ART

[Description of the Prior Art] In recent years, the spread of mobile walkie-talkie terminals, such as a cellular phone, is progressing quickly, and use of an immense number of walkie-talkies is expected in the still nearer future. Moreover, in order to plan the telecommunications service which used two or more frequency bands, such as terrestrial data broadcasting in 2000 and afterwards, in addition to the cellular phone and to use two or more services by one set of a terminal, the antenna which operates in small, a broadband, or two or more bands is needed.
[0003] Although it is common in communication terminals, such as the present cellular phone, that the antenna which corresponded for every use frequency is formed, the frequency change antenna corresponding to two or more frequencies is also reported. For example, the antenna (henceforth a "patch multilayer antenna") of the structure which accumulated the patch antenna of each frequency band in the shape of a multilayer is proposed as an example for which the conventional frequency change type antenna improved the array antenna component (illustration and "antenna" Institute of Electronics, Information and Communication Engineers P.229).
[0004] Moreover, the antenna of the structure changed with a transistor etc. is proposed [value / of the matching circuit of an antenna / inductance] in the change of a frequency (Takebe, east:"frequency change type miniaturized antenna in field radio" 1997 **** communication link society convention B-1-52). This changes resonance frequency in the pattern for electric supply formed in the antenna element by supplying electric power by capacity coupling and changing an inductance value by the PIN diode. However, the structure of the former patch multilayer antenna is the structure which accumulates two or more antennas, and there are antenna structure and a problem that the electric supply approach will become complicated. Moreover, in the change of the latter frequency, the antenna of the structure changed with a transistor etc. has a limitation in the change of a frequency, and has [value / of the matching circuit of an antenna / inductance] the problem that a matching circuit system becomes complicated.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] as mentioned above -- according to the multiplex loop antenna of this invention -- an electric supply loop formation -- a conductor and the loop formation non-supplied electric power -- it is the simple configuration that a conductor comes to adjoin, and compared with the conventional frequency change type antenna which changes a frequency, a complicated matching circuit is unnecessary and the miniaturization of an antenna can be realized.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] This invention was made in order to solve such a technical problem of the conventional antenna, and it aims to let antenna structure and an electric supply configuration offer the antenna equipment whose change of a desired frequency is attained simply and small, even if it does not change the frequency by the complicated matching circuit.
[0006]

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] invention of claim 1 -- touch-down -- at least two or more similarity-loop formations established through the conductor, the dielectric layer, and this dielectric layer -- the multiplex loop antenna which consists of a conductor -- it is -- said loop formation -- the loop formation as an electric supply loop formation with other one of the conductors -- it is made for a conductor to operate as a loop formation non-supplied electric power
[0007] invention of claim 2 -- a multiplex loop antenna according to claim 1 -- setting -- as said dielectric layer -- a dielectric plate -- using -- one field of this dielectric plate -- said touch-down -- a conductor -- preparing -- said loop formation -- as a conductor -- the field of another side of said dielectric plate -- a stripline -- at least two or more similarity-loop formations -- a conductor is formed.
[0008] invention of claim 3 -- a multiplex loop antenna according to claim 1 or 2 -- setting -- said at least two or more similarity-loop formations -- each loop formation of a conductor -- the one-wave rectangle loop formation corresponding to a desired exciting frequency for a conductor -- it considers as a conductor.
[0009] the loop formation to which invention of claim 4 operates as said electric supply loop formation in a multiplex loop antenna given in claim 1 thru/or any 1 term of 3 -- the end of a conductor -- said touch-down -- the loop formation which grounds to a conductor, and connects the other end to feeders, such as a coaxial track, and operates as said loop formation non-supplied electric power -- a conductor -- the both ends -- said touch-down -- it grounds to a conductor.
[0010] the loop formation to which invention of claim 5 operates as said loop formation non-supplied electric power in the multiplex loop antenna of a publication in claim 1 thru/or any 1 term of 4 -- the loop formation which operates as said electric supply loop formation which adjoined it and was established in the signal excited to the conductor -- it is made for a conductor to detect
[0011] invention of claim 6 -- a multiplex loop antenna given in claim 1 thru/or any 1 term of 3 -- setting -- said at least two or more similarity-loop formations -- each loop formation of a conductor -- the end of a conductor -- said touch-down -- by grounding to a conductor and changing the other end to a feeder or insulating edges, such as said coaxial track, with a switch etc., an electric supply loop formation and the loop formation non-supplied electric power are changed, and an antenna exciting frequency is changed.
[0012] Invention of claim 7 is set to a multiplex loop antenna according to claim 6. It is the antenna with which it comes to arrange a conductor. the loop formation which operates as said electric supply loop formation in the center -- the loop formation which operates as said loop formation non-supplied electric power on a conductor, and its inside and outside -- said inner loop, when reading the frequency of a conductor said inner loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said outer loop -- the both ends of a conductor -- an insulating edge -- connecting -- moreover, said outer loop, when reading the frequency of a conductor said outer loop -- the both ends of a conductor -- said touch-down -- a conductor -- grounding -- said inner loop -- the both ends of a conductor are made to change a frequency by connecting with an insulating edge.
[0013] invention of claim 8 -- a multiplex loop antenna according to claim 6 -- setting -- two loop formations -- a conductor -- using -- each loop formation -- the end of a conductor -- said touch-down --

the loop formation of a frequency to ground and read to a conductor -- the other end of a conductor -- said touch-down -- a conductor -- connecting -- another loop formation -- it is made to change a frequency by connecting the other end of a conductor to feeder ways, such as said coaxial track.
[0014]
[Embodiment of the Invention] the multiplex loop antenna of this invention -- tabular touch-down -- a conductor -- a dielectric layer is prepared upwards, sequential formation is carried out and antenna loop structure is constituted by the top face. the touch-down used for this invention -- although there is especially nothing that is limited as a conductor, conductors, such as copper with high conductivity, are desirable. Moreover, as dielectric materials used for a dielectric layer, what has the small dielectric loss in RF fields, such as a glass epoxy resin, Teflon (trademark), and an alumina, is desirable. and -- as the ingredient used for an antenna loop -- the conductor in a RF field -- loss is small and conductive ingredients, such as copper which is easy to process it, are desirable. Below, this invention is explained based on the drawing in which the gestalt of the operation is shown.
[0015] (Gestalt 1 of operation) Drawing 1 is the perspective view of one example of the multiplex loop antenna concerning this invention. the substrate which covered copper foil here to both sides of a tabular glass epoxy resin -- using -- the copper foil of one field of a substrate -- touch-down -- it considered as the conductor, the copper foil of another field was processed into the loop antenna of a stripline, and antenna equipment was produced. the copper foil of one field of a substrate -- touch-down -- the loop formation which becomes a conductor 1, the dielectric layer 2 which consists of a glass epoxy resin plate on it, and its top face from the stripline of copper foil -- sequential formation of the conductors 31-33 is carried out. The thickness of the used glass epoxy resin plate is 1.6mm, and line breadth of the loop antenna of a stripline was altogether set to 1.5mm here.
[0016] Drawing 2 is drawing for explaining the loop arrangement of the multiplex loop antenna of drawing 1 . Here, the overall length L of an antenna loop is prescribed by activation wavelength lambdag of the sending and receiving electric wave of an antenna, and activation wavelength lambdag of the sending and receiving electric wave of an antenna is expressed with degree type lambda g=lambda / rootepsiloneff when lambda and the effective dielectric constant as a stripline are set to epsiloneff for the wavelength of the electric wave which spreads the inside of a vacuum or air. at this time if loop-formation overall-length L=lambdag -- a loop formation -- a conductor 31 is a loop antenna equivalent to frequency =550MHz. a loop formation -- a conductor 32 is a loop antenna equivalent to frequency =608MHz. a loop formation -- a conductor 33 is a loop antenna equivalent to frequency =680MHz.
[0017] a loop formation -- a conductor 32 -- an electric supply loop formation -- it is -- an end -- touch-down -- it is grounded by the conductor 1 and the other end is connected to the coaxial track. a loop formation -- a conductor 31 and a loop formation -- as shown in a conductor 33 at drawing 2 (B), two switches for a change are formed, respectively. first, a loop formation -- an approach to read a conductor 31 is explained with reference to a drawing. it is shown in drawing 2 (A) -- as -- a loop formation -- the both ends of a conductor 31 -- touch-down -- a conductor 1 -- grounding -- a loop formation -- the both ends of a conductor 33 are connected to an insulating edge. a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 31 -- drawing 2 (C) -- a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 33 is shown in drawing 2 (D), respectively. this time -- a loop formation -- the electric supply loop formation which excited the conductor 31 and adjoined -- the loop formation described above with the conductor 32 -- the component of the frequency of the loop antenna equivalent to the loop-formation length of a conductor 31 is detected. The return loss (RL) property and standing-wave ratio property (SWR) of this antenna equipment are shown in drawing 3 (A).
[0018] According to drawing 3 (A), it resonates near 550MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Moreover, near 275MHz, since it is resonating on the frequency equivalent to antenna overall-length L=2lambdag, the frequency near 275MHz is also detected.
[0019] next, it is shown in drawing 2 (F) as an example of a comparison -- as -- a loop formation -- the end of a conductor 31 -- touch-down -- a conductor -- grounding -- the other end -- an insulating edge --

connecting -- a loop formation -- it connected with the insulating edge and the both ends of a conductor 33 were measured similarly. this time -- a loop formation -- the loop formation which did not excite the conductor 31 but adjoined -- a conductor 32 -- a loop formation -- the frequency component equivalent to the loop antenna equivalent to the loop-formation length of a conductor 31 was not detected.
[0020] next, a loop formation -- an approach to read a conductor 33 is explained with reference to a drawing. it is shown in drawing 2 (E) -- as -- a loop formation -- the both ends of a conductor 33 -- touch-down -- a conductor -- grounding -- a loop formation -- the both ends of a conductor 31 are connected to an insulating edge. a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 31 -- drawing 2 (D) -- a loop formation -- the connection state diagram of the changeover switch of the loop-formation edge of a conductor 33 is shown in drawing 2 (C). this time -- a loop formation -- the electric supply loop formation which excited the conductor 3 and adjoined -- a conductor 32 -- a loop formation -- the frequency component of the loop antenna equivalent to the loop-formation length which the conductor 33 described above is detected. The return loss (RL) property of antenna equipment in this case and a standing-wave ratio (SWR) property are shown in drawing 3 (B). According to drawing 3 (B), it resonates near 680MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Here, since resonance has taken place by antenna overall-length L=2lambdag similarly, the frequency near 340MHz is also detected.
[0021] (Gestalt 2 of operation) Drawing 4 is the perspective view showing other examples of the multiplex loop antenna of this invention. the substrate with which the antenna of this example also covered copper foil to both sides of a tabular glass epoxy resin -- using -- the copper foil of one field of a substrate -- touch-down -- it considered as the conductor, and the copper foil of another field was processed into the loop antenna of a stripline, and was produced. the copper foil of one field of a substrate -- touch-down -- the loop formation which becomes a conductor 1, the dielectric layer 2 which consists of a glass epoxy resin plate on it, and its top face from the stripline of copper foil -- a conductor -- sequential formation of the structures 31 and 32 is carried out. The thickness of the used glass epoxy resin plate is 1.6mm like said example. moreover, the loop formation of a stripline -- a conductor -- the line breadth of an antenna is 1.5mm altogether here.
[0022] Drawing 5 is drawing for explaining the loop structure of the multiplex loop antenna of drawing 4 . Here, the antenna loop overall length L is prescribed by lambdag, and is expressed with lambda g=lambda / rootepsiloneff (epsiloneff: effective dielectric constant as a stripline). at this time if loop-formation overall-length L=lambdag -- a loop formation -- a conductor 31 is a loop antenna equivalent to frequency =608MHz. a loop formation -- a conductor 32 is a loop antenna equivalent to frequency =740MHz.
[0023] moreover, two loop formations -- conductors 31 and 32 -- respectively -- one loop-formation edge -- touch-down -- it is grounded by the conductor and two frequencies are changed by the difference in the connection method of another loop-formation edge. both loop formations -- it is shown in conductors 31 and 32 at drawing 5 (B) -- as -- a loop formation -- one switch for a change changed to the earth side and a feeder road side is formed in another edge of a conductor.
[0024] first, a loop formation -- an approach to read a conductor 31 is explained according to a drawing. it is shown in drawing 5 (A) -- as -- a loop formation -- the both ends of a conductor 31 -- touch-down -- a conductor -- grounding -- a loop formation -- the end of a conductor 32 is connected to a feeder way. this time -- a loop formation -- the electric supply loop formation which excited the conductor 31 and adjoined -- a conductor 32 -- a loop formation -- the frequency component of the loop antenna equivalent to the loop-formation length of a conductor 31 is detected. The return loss (RL) property of this antenna equipment and a standing-wave ratio (SWR) property are shown in drawing 6 (A).
[0025] It resonates near 608MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Moreover, in this property, near 300MHz, since resonance has taken place by antenna overall-length L=2lambdag, it turns out that the frequency near 300MHz is also detected.
[0026] next, a loop formation -- an approach to read a conductor 32 is explained according to drawing. it is shown in drawing 5 (C) -- as -- a loop formation -- the both ends of a conductor 32 -- touch-down -- a conductor 1 -- grounding -- a loop formation -- the end of a conductor 31 is connected to a feeder way.

this time -- a loop formation -- the electric supply loop formation which excited the conductor 32 and adjoined -- a conductor 31 -- a loop formation -- the frequency component of the antenna equivalent to the loop-formation length of a conductor 32 is detected. The return loss (RL) property of this antenna equipment and a standing-wave ratio (SWR) property are shown in drawing 6 (B).
[0027] It resonates near 740MHz and it turns out that the value of a standing-wave ratio (SWR) is also good. Here, since resonance has taken place by antenna overall-length L=2lambdag similarly, it turns out that the frequency near 370MHz is also detected.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing one example of the multiplex loop antenna of this invention.
[Drawing 2] the loop formation of the multiplex loop antenna of drawing 1 -- a conductor -- it is drawing for explaining a configuration.
[Drawing 3] It is drawing showing the return loss (RL) property and standing-wave ratio (SWR) property of a multiplex loop antenna of drawing 1 .
[Drawing 4] It is the perspective view showing other examples of the multiplex loop antenna of this invention.
[Drawing 5] the loop formation of the multiplex loop antenna of drawing 4 -- a conductor -- it is drawing for explaining a configuration.
[Drawing 6] It is the graph which shows the return loss (RL) property and standing-wave ratio (SWR) property of a multiplex loop antenna of drawing 4 .
[Description of Notations]
1 -- touch-down -- a conductor, 2 -- dielectric layer, and 31 - 33 -- loop formation -- a conductor.

[Translation done.]

* NOTICES *

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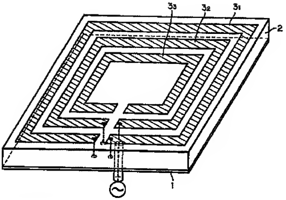
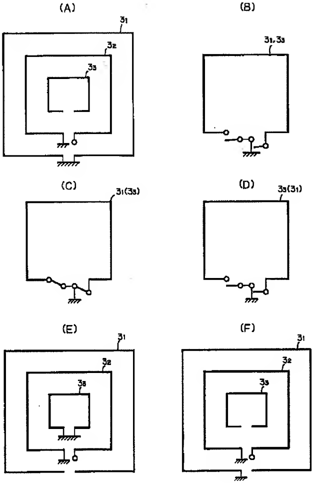
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

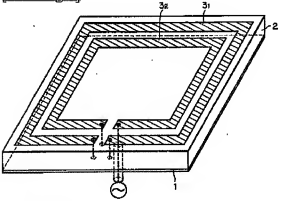
[Drawing 1]



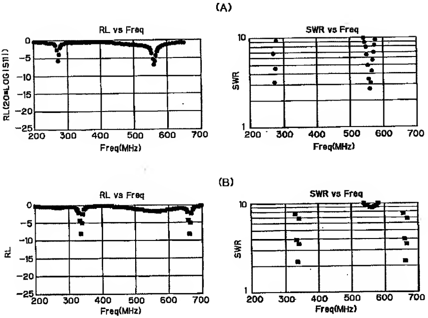
[Drawing 2]



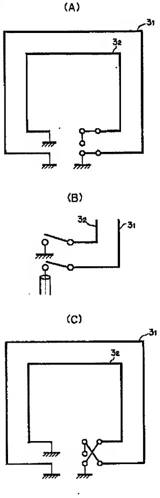
[Drawing 4]



[Drawing 3]

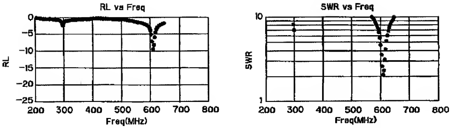


[Drawing 5]

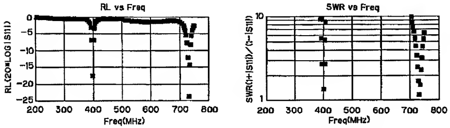


[Drawing 6]

(A)



(B)



[Translation done.]